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Abkhaz Stress as a Segmental Property

Abstract

This paper deals with the phonology of word stress in Abkhaz. Stress is both contrastive, forming minimal pairs, and dynamic, with stress placement alternating within morphological paradigms. I evaluate several theories of how Abkhaz stress should be represented, focusing on the size of units which host stress contrasts in the lexicon. A full analysis of Abkhaz stress requires an understanding of schwa, and I present arguments from exceptionless phonotactic restrictions that schwa is predictably epenthesized based on stress. I compile and analyze a corpus of 644 stress alternations, the largest dataset used in the literature. A subset of 426 alternations is used to evaluate four theories, where underlying stress specifications appear once per morpheme (Dybo 1977), syllable (Trigo 1992), mora (Kathman 1992, Vaux and Samuels 2018), or segment (Andersson 2020). The moraic and segmental analyses are the most successful, with 97% and 100% empirical coverage respectively. Arguments from consonant clusters and schwa distribution introduce additional problems for the moraic account, suggesting that Abkhaz stress is a property of individual segments in the lexicon. I conclude that the units capable of bearing stress can be as small as the segment, and may be more crosslinguistically variable than previously assumed.

Abkhaz Stress as a Segmental Property

Samuel Andersson*

1 Introduction

This paper investigates the stress system of the standard Abzhuy dialect of Abkhaz [abk], a North-west Caucasian language spoken primarily in Abkhazia. There are perfect minimal pairs for stress, and stress alternations within morphological paradigms are widespread, as in (1).¹

- (1) a. [á-la] ‘the eye’
 [a-lá] ‘the dog’
 b. [á-lah^{wa}] ‘the raven’
 [lah^{wa}-k’] ‘a raven’
 c. [a-labá] ‘the stick’
 [a-laba-k^{whá}] ‘sticks’

The distribution of schwa in the language is closely connected to the stress system, and an analysis of schwa is required to understand stress. Based on exceptionless phonotactic restrictions across the Abkhaz lexicon, I argue that schwa is not a phoneme. Instead, it is predictably epenthesized whenever stress would otherwise fall on a consonant. An alternative analysis where schwa is phonemic, but deleted in unstressed position, fails to predict restrictions on schwa distribution.

In order to study the stress system, I have compiled and analyzed a corpus of 644 stress alternations of the type seen in (1b-c), based on dictionary materials (Yanagisawa 2010). This corpus is used to test four theories of Abkhaz stress empirically. The theories use the same algorithm to assign surface stress based on underlying forms, known as Dybo’s Rule (Dybo 1977). However, each theory differs in which units carry stress contrasts underlyingly: the morpheme (Dybo 1977), the syllable (Trigo 1992), the mora (Kathman 1992, Vaux and Samuels 2018), and the segment (Andersson 2020). Every theory is tested on a large set of stress alternations, to see how much of the data is accounted for. Only the segmental theory reaches 100% empirical coverage, although a moraic analysis correctly predicts 97% of the alternations. Additional arguments from long consonant clusters and schwa epenthesis favor the segmental theory. I conclude that Abkhaz stress is a property of individual segments. Segmental stress is not currently known from other languages.

The remainder of this paper is structured as follows. Section 2 argues that schwa is epenthetic. Section 3 introduces the data on Abkhaz stress, and divides 644 stress alternations into patterns. Section 4 discusses theories of Abkhaz stress, and tests them against the stress data from Section 3. Section 5 covers moraic and segmental analyses of Abkhaz stress in more detail, arguing that the segmental theory is preferable for empirical and theoretical reasons. Section 6 concludes.

2 The Status of Schwa

Before investigating stress in Abkhaz, it is necessary to examine schwa, whose distribution is intimately related to the stress system. In this section I analyze phonotactic restrictions and alternations, which I use to argue that schwa is not a phoneme in Abkhaz. Instead, schwa is epenthetic, being inserted whenever stress would otherwise be expected to fall on a consonant.

The special status of schwa in Northwest Caucasian languages has been discussed in previous literature. Some favor analyses with non-phonemic schwa (Kuipers 1960, Allen 1965, Anderson 1978), while grammars of Abkhaz describe /a, ə/ as the two native vowel phonemes (Hewitt 1979, Spruit 1986, Chirikba 2003, Hewitt 2010, Yanagisawa 2013). Other vowels appear allophonically in native words, and contrastively in loanwords. Below I will consider how the distribution of schwa

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¹All data come from Yanagisawa (2010) unless otherwise noted. Stress is marked with acute accents.

relates to stress, as well as phonotactic restrictions which apply to [ə] but not [a].

Many morphemes show alternations where the location of stress and the presence of schwa covary, so that schwa is present where there is stress, and vice versa. In (2) this gives rise to alternations such as [nap'ə]-[nap'] 'hand', (2a), and [sə-la]-[s-] 'my', (2b).

- (2) a. [a-nap'ə] 'hand'
 [a-nap'-k^{wh}á] 'hands'
 b. [sə-la] 'my eye'
 [s-labá] 'my stick'

One possibility is that there are underlying schwas which delete in unstressed position. 'my stick' would be /sə-laba/ underlyingly, with unstressed schwa deletion producing [s-labá]. Another possibility is that schwa is non-phonemic, and predictably epenthesis under stress. The first-person singular possessive morpheme would be monoconsonantal /s-/ underlyingly. When stress falls on the prefix (see Section 4.1 on stress placement), a schwa is epenthesis, as in /s-la/ [sə-la] 'my eye'.

Two arguments favor the latter, epenthetic analysis, where schwa is not phonemic. Firstly, there do not appear to be any minimal pairs for schwa vs. the absence of a vowel, which do not also differ in stress (see Andersson 2020, Vaux et al. submitted). If a phone has a predictable distribution and cannot form minimal pairs, it does not need to be entered into underlying representations.² Another argument comes from the phonotactic restrictions in (3). The numbers below were extracted from Yanagisawa's (2010) dictionary of over 6,000 headwords. They are exceptionless across native, borrowed, and morphologically complex words.

- (3) a. There are 136 morphemes beginning in [a], but none beginning in [ə]³
 b. There are 587 tokens with [aa] vowel hiatus, but no hiatus tokens with [ə]

We should seek theories of Abkhaz which explain these restrictions. If schwa is underlying, separate stipulations will have to be used to derive (3). However, if surface schwa reflects epenthesis when stress would otherwise fall on a consonant, the phonotactic facts follow automatically. Morphemes beginning in schwa are impossible, (3a), since there is no preceding consonant to motivate epenthesis. Schwa in hiatus is impossible, (3b), since in vowel hiatus there is no preceding consonant to motivate epenthesis. If schwa were underlying, there would be no reason why it should be banned in exactly the positions predicted by the epenthesis account.

For the reasons above, I argue that schwa is not a phoneme in Abkhaz, and that it is always epenthesis where it does appear. Its distribution is predictable, and there are exceptionless phonotactic restrictions which follow perfectly from this epenthetic analysis. With this background on schwa as a predictable, epenthetic vowel, the next section discusses the stress system.

3 Empirical Generalizations about Stress

This section surveys a dictionary-based corpus of 644 stress alternations in Abkhaz, the largest dataset used to study Abkhaz stress to date. Several generalizations emerge from the data. Firstly, there are strong restrictions on Abkhaz stress, and few of the logically imaginable stress alternations are actually attested. Secondly, the number of stress patterns grows with the length of the stem, so that CVCVCV stems show more stress patterns than CV stems. Finally, manipulating the number of vowels in a stem does not change the number or type of stress patterns. CVCV and CC stems, for example, have exactly the same set of possible stress alternations. 16 of the 644 stress alternations are rare, and do not fit into any of the regular categories. I also define a subset of 426 alternations, consisting of regular stress patterns on stems of the most common sizes (CVCVCV or shorter), and which only contain native vowels. This core dataset will be used to evaluate theoretical analyses of

²Some unstressed schwas exist, which break up consonant clusters which otherwise do not occur (Spruit 1986, Chirikba 2003), and have also been argued to be predictable (Yanagisawa 2005).

³One morpheme, the agreement prefix /j-/, appears as [ə-] in particular syntactic environments (Chirikba 2003:21).

Abkhaz in the next section. Below I first describe the methodology used to extract the 644 alternations (Section 3.1), and discuss the regular patterns and their type frequencies (Section 3.2). Section 3.3 motivates the existence of exceptions, and gives an exhaustive list of all exceptional alternations.

3.1 Corpus Methodology

This section introduces the corpus used to study stress alternations in Abkhaz. I describe the source of the data, motivations for any exclusion, and methodological details in how the data were extracted. All data come from Yanagisawa (2010), who provides morphologically related forms of headwords, and marks the stress on these related forms consistently. All judgments on stress were provided by Anna Tsvinaria-Abramishvili, from the Ochamchira district of Abkhazia.

Following a long tradition in the Abkhaz literature, stress alternations can be illustrated with definite and indefinite forms of nouns and adjectives (Dybo 1977 et seqq.). Definite forms, which are the citation form, are prefixed with [a-], and appear as headwords in the dictionary. Indefinite forms have a suffix [-k'ə̃]. Although nominal paradigms in Abkhaz are not much bigger than this, stress shifts can and do occur elsewhere. However, definite and indefinite forms are often used because they are diagnostic of stress category. There are no more stress patterns than can be deduced from these two forms (Spruit 1986). Verbs are significantly more complex morphosyntactically than nominals (Hewitt 1979, Chirikba 2003), and how accentuation is influenced by the syntax-phonology interface is poorly understood (but see Trigo 1992). With nouns and adjectives, we can study stress patterns in a more controlled environment, with a small set of morphemes. Future work will address additional forms from nominal paradigms, as well as stress shifts in the verbal domain.

From a .pdf version of the dictionary graciously provided by Tamio Yanagisawa, a plaintext version was created. Items tagged with [n.] for noun and [adj.] for adjective were extracted using Python scripts. This resulted in a list of 2,214 nouns and adjectives, all in the modern Cyrillic orthography. Any item which did not have both a definite and indefinite form was excluded. Words with stress on long [aa] were also excluded. Yanagisawa (2010:14) states that his consultant did not distinguish between [áa] and [aá], and so the stresses on these forms were supplied based on etymological considerations rather than native speaker judgments. With these exclusions, the dataset was reduced to 1,288 words, in 644 definite-indefinite pairs. These were stored in the orthography, and in an abstract phonological form where all consonants were replaced by 'C', and vowels were romanized. This was done to facilitate searching through the dictionary for particular stress patterns for Section 3.2. The Abkhaz orthography is phonemic, meaning that conversions between orthography and phonology are straightforward. Having seen how the corpus is structured, the next section will examine the stress alternations and their type frequencies.

3.2 Core Stress Patterns in Abkhaz

This subsection surveys the empirical generalizations that emerge from the corpus. I will exemplify stress patterns by stem length and by the phonotactic makeup of each stem. I also give the type frequency of each pattern, i.e. how many words across the corpus show the same pattern. Although there are minor differences in frequencies, all patterns are robustly attested. Exceptional patterns with lower type frequencies are discussed in the Section 3.3.

(4-5) begins with the shortest attested stems in Abkhaz, those of shape C(V).⁴ This includes /Ca/ stems, as well as C(ə̃) stems, which alternate [C]~[Cə̃] on the surface but are underlyingly /C/ (see Section 2). For these stems the numbers are in (4-5). I give an example definite and indefinite form together with a translation. I also give the abstract pattern which the word is instantiating, and how many other words in the corpus share this pattern. (4a), (5a) show stress on the stem in both forms, while (4b), (5b) alternate between prefix stress in the definite, and stem stress in the indefinite.

(4)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-dzə̃]	[dzə̃-k']	'water'	[a-Cə̃]~[Cə̃-k']; 19
b.	[á-dz]	[dzə̃-k']	'flea'	[á-C]~[Cə̃-k']; 8 ⁵

⁴Though phonotactically possible, there is no stem /a/ (Spruit 1986:44).

⁵The indefinite can also be [C-k'ə̃]. I set aside these forms, since optionality is not consistently reported.

(5)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-lá]	[lá-k']	'dog'	[a-Cá]~[Cá-k']; 17
b.	[á-la]	[lá-k']	'flea'	[á-Ca]~[Cá-k']; 10

For C(V)C(V) stems, the frequency results are shown below. I present all possible stem shapes, in the order C(ə)C(ə), C(ə)Ca, CaC(ə), CaCa. (6a), (7a), (8a), (9a) show stem-final stress in both forms, while in (6b), (7b), (8b), (9b) stress is stem-initial in both forms. (6c), (7c), (8c), (9c) alternate between prefix stress in the definite, and stem-final stress in the indefinite.

(6)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-ʃʷǝ]	[ʃʷǝ-k']	'storm cloud'	[a-CCǝ]~[CCǝ-k']; 14
b.	[a-q'ǝz]	[q'ǝz-k']	'goose'	[a-CǝC]~[CǝC-k']; 25
c.	[á-χǝ]	[χǝ-k']	'hawk'	[á-CC]~[CCǝ-k']; 14
(7)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-pʰǝ]	[pʰǝ-k']	'wind'	[a-CCá]~[CCá-k']; 14
b.	[a-t'ǝʂa]	[t'ǝʂa-k']	'hole'	[a-CǝCa]~[CǝCa-k']; 15
c.	[á-bna]	[bná-k']	'forest'	[á-CCa]~[CCá-k']; 41
(8)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-k'asǝ]	[k'asǝ-k']	'shawl'	[a-CaCǝ]~[CaCǝ-k']; 11
b.	[a-k'át']	[k'át'-k']	'rod'	[a-CáC]~[CáC-k']; 23
c.	[á-sas]	[sasǝ-k']	'guest'	[á-CaC]~[CaCǝ-k']; 15
(9)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-labá]	[labá-k']	'stick'	[a-CaCá]~[CaCá-k']; 18
b.	[a-k'ába]	[k'ába-k']	'shirt'	[a-CáCa]~[CáCa-k']; 28
c.	[á-lah ^{wa} a]	[lah ^{wa} á-k']	'raven'	[á-CaCa]~[CaCá-k']; 13

For the longest stems considered, C(V)C(V)C(V), the lexicon is sparse (Chirikba 2003:21). Below I illustrate the five stress patterns found on CaCaCa stems. The type frequencies are pooled across the eight possible stem shapes. The forms in (10a) were provided by Zaira Khiba (p.c.), a speaker of Abzhuy Abkhaz from the same district of Abkhazia as Yanagisawa's consultant. (10a-c) show non-alternating patterns of stress in these two forms, which can fall on the final, medial, or initial stem syllable. (10d) alternates between prefix stress and stem-medial stress, while (10e) alternates between prefix stress and stem-final stress.

(10)	Definite	Indefinite	Translation	Pattern; type frequency
a.	[a-tʰ ^{wh} alá ^{wh} á]	[tʰ ^{wh} alá ^{wh} á-k']	'embryo'	[a-CaCaCá]~[CaCaCá-k']; 26
b.	[a-ts ^h aláq' ^{ja}]	[ts ^h aláq' ^{ja} -k']	'floorboard'	[a-CaCáCa]~[CaCáCa-k']; 39
c.	[a-tʰ ^{wh} ámat ^{wh} a]	[tʰ ^{wh} ámat ^{wh} a-k']	'underwear'	[a-CáCaCa]~[CáCaCá-k']; 42
d.	[á-zamana]	[zamána-k']	'fine (one)'	[á-CaCaCa]~[CaCáCá-k']; 20
e.	[á-sak'asa]	[sak'asá-k']	'stretcher'	[á-CaCaca]~[CaCaCá-k']; 14

Although longer stems exist, there are too few to allow for systematic study. I will therefore conclude the subsection with some generalizations about the data above. For each of the stem sizes some patterns have fixed stress (at least in the two forms considered here) and others alternating stress. C(V) stems have only two patterns, C(V)C(V) three, and C(V)C(V)C(V) five. Within each of these stem sizes, the presence or absence of vowels makes no difference to the number or type of stress patterns. This is especially clear in (6-9), where CC, CCa, CaC, and CaCa stems show identical stress patterns. The number of attested patterns is also small relative to the space of logical possibilities. The definite forms in (10) have four vowels in the definite form, and three in the indefinite. In theory there could be as many as 4 x 3 = 12 stress patterns on these stems, but in fact only five are found.

Any phonological analysis of Abkhaz stress must account for the strong restrictions on stress alternations, while also predicting the attested stress patterns. I take up this question in Section 4,

where several theories are compared to each other based on how well they predict the 426 stress alternations from (3-9).

3.3 Rare and Exceptional Stress Alternations

Beyond the main stress patterns illustrated in Section 3.2 above, a small number of unexpected alternations were found in the corpus of 644 word pairs. These forms are irregular in segmental content, stress placement, or both. I show all 16 of these forms in (11), classified based on their behavior:

(11) Segmental differences

- | | | | |
|----|--------------------------------------|---------------------------------------|--------------|
| a. | [a-p ^h h ^w áś] | [p ^h h ^w śá-k'] | ‘woman’ |
| b. | [a-wp'á] | [wáp'a-k'] | ‘felt cloak’ |

Prefix stress alternating with stem-initial stress

- | | | | |
|----|---|---|------------------------------|
| c. | [á-k ^h alak ^h] | [k ^h alak ^h -k'] | ‘city, town’ |
| d. | [á-k ^{wh} t ^f ^{wh}] | [k ^{wh} á ^t ^f ^{wh} -k'] | ‘top, summit’ |
| e. | [á-ləm] | [lóm-k'] | ‘lion’ |
| f. | [á-t ^h irt ^h a] | [t ^h irt ^h a-k'] | ‘place for selling, counter’ |
| g. | [á-t ^h ərk ^{wh} a] | [t ^h ərk ^{wh} a-k'] | ‘Turk’ |
| h. | [á-χ ^w əlp ^h a] | [χ ^w əlp ^h a-k'] | ‘evening’ |
| i. | [á-t ^f ^{wh} art ^h a] | [t ^f ^{wh} árt ^h a-k'] | ‘bed, bedroom’ |
| j. | [á-t ^f ^w ts ^h a] | [t ^f ^w əts ^h a-k'] | ‘glass’ |

Stress alternations within stem

- | | | | |
|----|---|---|---------------|
| k. | [a-dzós] | [dzsós-k'] | ‘kid’ |
| l. | [a-nóq'wau(ə)] | [nəq'wauə-k'] | ‘traveler’ |
| m. | [a-t'əmit'əga] | [t'əmit'əga-k'] | ‘abyss’ |
| n. | [a-t ^h ák'waz ^w] | [t ^h ak'waz ^w ə-k'] | ‘old woman’ |
| o. | [a-χárp ^h] | [χarp ^h ə-k'] | ‘shirt’ |
| p. | [a-χáh ^w] | [χah ^w ə-k'] | ‘stone, rock’ |

It may not seem justified to treat the words in (11) as exceptions rather than regular patterns ignored in Section 3.2. There are eight cases above of prefix stress alternating with stem-initial stress, which may seem indistinguishable from the eight examples of [á-C]~[Cə-k'] alternations in (4b). However, the data in (11) is pooled across stem shapes and sizes, which was not the case in Section 3.2. Considering all words which alternate between prefix and stem-final stress, the total count is 115, adding the numbers in (10e), (6c), (7c), (8c), (9c), and (4b), (5b). It seems justified to treat these 115 words as regular, and the eight words in (11c-j) as exceptions. Analogous considerations hold for the rest of the data in (11). Having established the regular and irregular stress alternations in Abkhaz, Section 4 compares several analyses of Abkhaz against each other on the basis of the regular data in Section 3.2.

4 Evaluating Theories of Abkhaz Stress Empirically

This section evaluates several theories of the representations used for stress in Abkhaz. Specifically, I will focus on which units host stress contrasts in the lexicon. There is little agreement in the literature, and hypotheses include specifying underlying stresses once per morpheme (Dybo 1977), once per syllable (Trigo 1992), or once per mora (Kathman 1992, Vaux and Samuels 2018). I introduce a new representational possibility, that stress is underlyingly specified once per segment. All previous work has relied on a single algorithm, known as Dybo’s Rule (1977), for placing surface stress given the underlying forms. For this reason, this section assumes Dybo’s Rule to be valid. This allows us to test how well a particular representation of stress accounts for the data in Section 3.2, while holding the stress computations constant. Only one theory, where segments carry stress contrasts, reaches 100% empirical coverage, but that a moraic analysis also fares well. Stress contrasts on syllables and morphemes, however, do not account for more than two thirds of the data each.

The implications are discussed in more detail in Section 5. The remainder of this section introduces Dybo's Rule (Section 4.1), and the theories to be compared (Section 4.2). Finally, Section 4.3 evaluates the empirical coverage of each theory against the data from Section 3.2.

4.1 Dybo's Rule

Dybo's Rule (or Dybo's Law) is the name given to a particular algorithm for assigning surface stress in Abkhaz, introduced in Dybo (1977). All subsequent work on Abkhaz stress has relied on Dybo's Rule to convert underlying into surface stresses. In Dybo's (1977) data, stress is assigned as in (12). Several implementations exist, and this paper does not discuss them further. Interested readers are referred to Kathman (1992), Trigo (1992), Vaux and Samuels (2018), and Andersson (2020).

- (12) a. Surface stress falls on the leftmost underlying stress not immediately followed by another underlying stress
 b. If no underlying stress exists, surface stress is final

The application of Dybo's Rule is illustrated in (13), using data from Dybo (1977). In (13a) surface stress falls on the only underlying stress. (13b) has two underlying stresses, on the prefix and the suffix. Since the root between them is unstressed, the prefix has an underlying stress not immediately followed by another underlying stress, and (12a) ensures it receives surface stress. (13c-d) have strings of adjacent underlying stresses. All morphemes are stressed underlyingly, but the final morphemes are not immediately followed by an underlying stress, since they are word-final. (12a) therefore gives final surface stress. Finally, (13e) illustrates the application of (12b), with final surface stress when no underlying stresses are present.

- | | | | |
|---------|---------------------------|---------------------------|---------------------------------|
| (13) a. | /á-bla/ | [á-bla] | 'the eye' |
| b. | /á-bla-k ^{wh} á/ | [á-bla-k ^{wh} a] | 'eyes' |
| c. | /á-lá/ | [a-lá] | 'the dog' |
| d. | /á-lá-k ^{wh} á/ | [a-la-k ^{wh} á] | 'dogs' |
| e. | /mg ^w a-la/ | [mg ^w a-lá] | 'stomach, belly (instrumental)' |

Note that in every approach based on Dybo's Rule, the definite prefix /á-/ is stressed, while the indefinite suffix /-k'/ is unstressed. These assumptions, argued for in Dybo (1977) and Spruit (1986), will be made throughout the rest of this paper.

4.2 Representations of Abkhaz Stress

Before evaluating theories of Abkhaz stress, this subsection discusses which theories to evaluate. I describe four theories of which units carry stress in Abkhaz underlying representations: morphemes, syllables, moras, and segments. Some theories are based very closely on proposals from the literature, while others are typologically common systems which depart somewhat from work on Abkhaz.

In the original proposal by Dybo (1977), every morpheme is either stressed or unstressed. If a polysyllabic morpheme is stressed, its stress is final (Dybo 1977:42-43). This account predicts only two possible stress patterns, contradicting the data in Section 3.2. Dybo in fact discusses three stress patterns, corresponding to (6-9)a, b, c. But since his account is historically oriented, he dismisses the (b) patterns as secondary developments. This paper is concerned with synchrony, and I will test the theory on all nominals in Section 3.2. This includes many morphologically complex forms. A full analysis of each of the 426 word pairs would be required to rule these out. This has not been feasible, and it should be kept in mind that the resulting comparisons therefore disfavor Dybo's (1977) theory somewhat.

Another possibility is that stress is carried by syllables. It has been claimed to be universally impossible for languages to have a stress-bearing unit other than the syllable (Hayes 1995:49, Hyman 2006:225). Trigo (1992) argues for a syllabic analysis of Abkhaz, but where "every consonant is underlyingly syllabic" (Trigo 1992:196). There is no independent evidence for abstract syllabic consonants, however, especially not underlying forms where *all* consonants are syllabic. I will investigate a theory where Abkhaz syllables must include a vowel, and can include complex onsets

which are independent of sonority, as seen in (11a) [p^hʰwśá-kʰ] ‘a woman’ and (13e) [mg^wa-lá] ‘stomach, belly (instrumental)’. This analysis predicts that stems with more syllables have more stress patterns, since they have room for additional underlying stress specifications. It also predicts a strong correlation between stem shape and number of stress patterns: disyllabic /CaCa/ stems should behave differently than monosyllabic /CaC/ or /CCa/ stems, for example. Section 3.2 showed that the first of these predictions is borne out, while the second is not.

Many have instead placed stress contrasts on moras in Abkhaz. Kathman (1992) and Vaux and Samuels (2018) are explicitly moraic accounts. Both are ultimately based on Spruit (1986), who originated the proposal, though without using the word ‘mora’. Kathman (1992) follows Spruit (1986) closely, while Vaux and Samuels (2018) modify the theory to be consistent with crosslinguistic restrictions on moras. The version of moraic theory considered here follows Kathman (1992). It also imposes a trimoraic maximum on syllables (Hayes 1989), and allows moraic onsets (Topintzi 2006). A discussion of the moraic account, including the version by Vaux and Samuels (2018), can be found in Section 5.

Finally, Andersson (2020) argues that Abkhaz stress contrasts are represented on individual segments. This is the most permissive of the theories in this section, in that it allows many possible stress patterns even on short, consonant-only stem shapes such as /CC/. Section 5 contains a fuller discussion of whether this is warranted. The next subsection is concerned with the empirical evaluation of the four theories discussed above.

4.3 Empirical Evaluation

Section 3.2 contained a set of 426 regular stress alternations in Abkhaz, and Section 4.2 introduced four representational theories aimed at explaining Abkhaz stress. I will evaluate each theory against the 426 stress alternations, to see what percentage of the data the theories account for. For each alternation, we can ask whether there is some underlying form in each theory which, when Dybo’s Rule applies to it, yields the attested surface form. The syllabic and morphemic analyses do poorly, neither capturing more than two-thirds of the alternations. The moraic analysis is more successful, with 96.9% empirical coverage. Only the segmental analysis achieves 100%.

Beginning with the morphemic theory by Dybo (1977), let us consider what is predicted for /CaCaCa/ stems. These are either stressed or unstressed, as all morphemes are under this hypothesis. This yields the two possibilities in (14) when Dybo’s Rule is applied. Stressed morphemes have an acute accent on their final vowel. In (14a), a stressed root leads to stem-final stress in both definite and indefinite forms. In (14b), the unstressed root leads to surface stress on the prefix in the definite form. The indefinite instead shows stem-final stress, just as in (14a).

- | | | | |
|---------|----------------|----------------|-----------------|
| (14) a. | /á-tʰwálaʃwá/ | [a-tʰwálaʃwá] | ‘the embryo’ |
| | /tʰwálaʃwá-kʰ/ | [tʰwálaʃwá-kʰ] | ‘an embryo’ |
| b. | /á-sakʰasa/ | [á-sakʰasa] | ‘the stretcher’ |
| | /sakʰasa-kʰ/ | [sakʰasá-kʰ] | ‘a stretcher’ |

However, these are only two of the five possibilities for stress on /CaCaCa/ forms from (10). The morphemic analysis therefore undergenerates. By going through the same process as in (14) for all stems in Section 3.2, we find all predicted stress alternations in this theory. These are (10a) and (10e), as shown in (14), (6-9)a, c, as well as both patterns in (4-5). Adding up the counts for these alternations in Section 3.2, the morphemic analysis predicts only 240 of the 426 alternations, representing 56.3% of the data. Recall from Section 4.2 that this is probably an underestimate.

The syllabic analysis predicts more alternations on some stems, and fewer on others. (15) shows that /CCa/ stems are predicted to have two stress patterns. Acute accents are placed on stressed syllables, and /CCa/ stems are assumed to have complex onsets. The two patterns shown in (15) are exactly analogous to (14).

- | | | | |
|---------|------------------------|------------------------|--------------|
| (15) a. | /á-p ^h śá/ | [a-p ^h śá] | ‘the wind’ |
| | /p ^h śá-kʰ/ | [p ^h śá-kʰ] | ‘a wind’ |
| b. | /á-bna/ | [á-bna] | ‘the forest’ |
| | /bna-kʰ/ | [bná-kʰ] | ‘a forest’ |

/CaCa/ stems would have additional possibilities, since there are two stem syllables which can carry stress. In total, the syllabic analysis can account for (4b), (5a-b), (6c), (7a) and (7c), (8b-c), (9a-c), and some of (10) depending on stem shape.⁶ The total coverage is 282 alternations out of 426, or 66.2%.

The moraic analysis covers almost all of the data, assuming that any consonant not immediately before a vowel is moraic. For example, the three stress patterns in (6), on underlying /CC/ stems, do not pose a problem. The stems have two moraic consonants, and therefore two stress specifications. The 2 x 2 combination of stressed and unstressed moras results in exactly the observed three stress alternations, as shown in (16). This is due to a neutralization in (16c-d), which show the same surface forms analyzed in two different ways underlyingly (Spruit 1986). Surface schwas appear when stress would otherwise fall on a consonant (see Section 2).

(16) a.	/á-ḥʷj/	[a-ḥʷjə]	‘the storm cloud’
	/ḥʷj-k/	[ḥʷjə-kʰ]	‘a wind’
b.	/á-qʰz/	[a-qʰəz]	‘the goose’
	/qʰz-k/	[qʰəz-kʰ]	‘a goose’
c.	/á-χʲj/	[á-χʲj]	‘the hawk’
	/χʲj-k/	[χʲjə-kʰ]	‘a hawk’
d.	/á-χʲj/	[á-χʲj]	‘the hawk’
	/χʲj-k/	[χʲjə-kʰ]	‘a hawk’

The only problems arise in /CCC/ stems, whose indefinite forms /CCC-kʰ/ need four moras, one for each consonant. A trimoraic maximum makes this impossible. There are 13 such stems, leading to an empirical coverage of 413 of 426 alternations, or 96.9%. A segmental analysis is not limited in the same way as the moraic one. The analysis is identical to the moraic theory for data like (16), but for longer stems there is no maximum of three segments per syllable. The empirical coverage is therefore 426 out of 426 alternations, or 100% (see Andersson 2020, who shows this in detail).

These data strongly support the moraic and segmental theories over syllabic and morphemic alternatives. Only the segmental analysis accounts for all alternations. This is a predictive success for the segmental theory. Despite this, we must be cautious to not overinterpret these percentages. The moraic analysis accounts for all but 13 forms, which could perhaps be treated as exceptional. It also seems to be more in line with the analysis of stress in other languages as a prosodic property and not a segmental one. The mora has been argued to carry stress in several languages (see Hale and White Eagle 1980 on Hoocak, Buller et al. 1993 on Banawá, Blevins and Harrison 1999 on Gilbertese, among others), but no language is currently known to have segmental stress. For these reasons, the next section discusses further differences between the moraic and segmental approaches, to investigate whether a segmental analysis is justified.

5 Discussion: Moras and Segments

The empirical evaluation of theories in the previous section clearly favors moras and segments as units hosting stress contrasts in Abkhaz. This section explores additional theoretical and empirical problems with the moraic account. Together with the results from Section 4, these arguments strongly suggest that Abkhaz stress contrasts are represented on individual segments.

Moraic theories are typically limited to three moras per syllable (Hayes 1989). Since Abkhaz consonants are moraic, these theories require clusters in Abkhaz syllables to be similarly limited. However, strings of four or more (moraic) consonants are by no means impossible. They occur freely in native words, (17a-b), as well as in loanwords, (17c-d). Note that schwas are epenthetic.

(17) a.	[pʰstʰhʷá-kʰ]	‘a cloud’
b.	[kʰərtsʰhχ-kʰ]	‘a (piece of) hail’
c.	[tsʰéntʰr-kʰ]	‘a center’

⁶(10a) is predicted on stems /CCCa, CCaCa, CaCCa, CaCaC/, (10b) on /CCaC, CCaCa, CaCaC/, (10c) on /CaCC, CaCCa, CaCaC/, (10d) on /CaCaC/. All stem shapes allow (10e), and /CaCaCa/ stems allow all of (10a-e)

d. [ndʒnár-kʰ] ‘an engineer’

Affixal morphology can create syllables with up to six moras, as in [pʰs-tʰw-kʰwó-w-pʰ] ‘(they) are animals’ (Ajiba and Habat 2006:61). Sentences with clusters like those in (18) come up naturally in elicitations, and do not reflect the efforts of linguists to deliberately create long clusters.

- (18) [á-χʲf-tʰwʰa ʊnár-tʰw pʰs-tʰwó-s á-ʃχa jə-kʰá-r-tsʰo-z-ej]
 the.herders domestic animal the.mountain what.kind.do.they.
 drive.away

‘What kind of domestic animals are the herders driving away to the mountain?’

These examples show that the three-mora maximum introduces serious empirical problems. Vaux and Samuels (2018) attempt to resolve this by arguing that consonant clusters never contrast for stress. A stem like /CCCa/ would be monomoraic, and so only have two possibilities for stress. Long clusters then no longer pose a problem, since each consonant does not bear its own stress. This also removes moraic onsets from the language, since onsets now share a stress specification with the nucleus. However, there are good arguments that schwa is epenthetic (Section 2), and this means Vaux and Samuels’ (2018) theory cannot be maintained. Underlying consonant clusters do contrast for the location of schwa epenthesis, and if epenthesis is stress-governed, the clusters must also contrast for stress. Some near-minimal pairs are shown in (19).

- (19) a. /á-pʰfʷ/ [a-pʰóʃʷ] ‘the lip’
 /á-pʰsʰ/ [a-pʰsʰ] ‘the soul’
 b. /á-tʰʂʰbʰka/ [a-tʰʂʰbʰka] ‘the saddle’
 /á-tʰʂʰbʰga/ [a-tʰʂʰbʰga] ‘the scythe’

These data suggest that a moraic theory of Abkhaz stress does not work. Imposing limits on the number of moras per syllable fails to account for long consonant clusters. Attempts to remove those limits leads to incorrect predictions about schwa epenthesis. A segmental theory does not have any of these problems, and is the only theory which accounts for 100% of the regular stress alternations in Section 4. Andersson (2020) also discusses underlying forms like /ĆV/, which are only possible if segments carry stress. These appear across, and, rarely, within morphemes, providing empirical support for a segmental analysis (but see Kathman 1992).

If stress is a segmental property in Abkhaz, a question arises as to how it should be represented. Andersson (2020) argues for a featural analysis using [stress]. Since Abkhaz stress is a binary property of individual segments, it looks much like other phonological features. Analyses with metrical grids would also be possible, with Line 0 asterisks for segments rather than syllables (Trigo 1992) or moras (Kathman 1992, Vaux and Samuels 2018). No purely foot-based theories of Abkhaz stress currently exist, and the usual formulation of FtBin places size restrictions on feet in terms of moras and syllables, rather than segments (Prince and Smolensky 1993). However, with theoretical modifications such an analysis seems possible. I will not favor either theoretical approach here, and conclude instead that however it is analyzed, Abkhaz stress is a property of the segment.

6 Conclusion

This paper has investigated the Abkhaz stress system by examining patterns across the lexicon, through a corpus of 644 stress alternations. I have argued that schwa is not a phoneme in Abkhaz, and that it is epenthized whenever stress would otherwise fall on a consonant. This is supported by exceptionless phonotactic restrictions across thousands of native and borrowed words. This has implications for the stress system, since many stems consist only of consonants underlyingly when schwa is removed. In order to study these implications, I have evaluated four hypotheses about which units carry stress in Abkhaz underlying forms: morphemes, syllables, moras, and segments. This was done by applying Dybo’s Rule, the algorithm for assigning surface stress in Abkhaz, to underlying forms with all possible stress specifications permitted by each theory. The predictions could then be tested against a corpus of 426 regular stress alternations, to evaluate the empirical coverage of the theories.

The moraic and segmental analyses were the most successful, and the segmental analysis is the only one to account for 100% of the data. Limiting syllables to a maximum of three moras prevents the moraic theory from accounting for long consonant clusters. Attempts to circumvent these limitations face empirical problems in the location of schwa epenthesis. I conclude that Abkhaz stress is a property of individual segments in underlying forms. The possibility of stress contrasts carried by segments is not currently known from any other language. Abkhaz suggests that the typology of possible stress-bearing units may be broader than previously assumed, and shows that careful empirical studies still have much to teach us about the basic properties of the phonology of stress.

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